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54) [Title of the invention]

Metal halide lamp.

57) [Summary]

[Problem]

By the fact that the vapour pressure of the metal halide is suppressed, changes of the lamp voltage and the colour temperature in the course of time are reduced. Moreover, by the fact that the site that greatly influences the decision of the vapour pressure is established in a site with as much as possible no influence on the light radiation moiety, the accumulation of metal halide is controlled and the radiation efficiency of the light is improved.

[Means of solution]

By the fact that, corresponding with the changes of the electric field, the number of revolutions of cooling fan 6 is caused to change, and that the temperature that greatly influences the decision of the vapour pressure is kept fixed, changes in the course of time of the lamp voltage and colour temperature are eliminated. Moreover, by the fact that heat insulating film moiety 4 is locally cooled, the accumulation of the liquid phase moiety of a metal halide is fixed to heat insulating film moiety 4, and the rate of radiation efficiency of light can be improved.

[What is claimed]

[Claim 1]

A metal halide lamp with the characteristic that it is a metal halide lamp that has been arranged in the front surface of a reflecting mirror that has a reflecting surface, and that it has been equipped with a means that locally cools the light emitting tube moiety of the lamp.

[Claim 2]

The metal halide lamp that has been described in claim 1, with the characteristic that a local cooling moiety is executed, so that the metal halide in the saturated state is

positioned in the inner side of a heat insulating film that has been painted in the vicinity of the sealing moiety of the discharge electrode of the lamp.

[Claim 3]

The metal halide lamp that has been described in claim 1, with the characteristic that it has been equipped with a local cooling means that comes to cause the degree of cooling to change, corresponding with the changes of the lamp's electric field.

[Claim 4]

The metal halide lamp that has been described in claim 1, with the characteristic that the local cooling means is constituted by a fan and nozzle for air blowing, that one end of the nozzle is connected with the fan for air blowing, and that the other end is arranged in the vicinity of the lamp's cooling moiety.

[Claim 5]

The metal halide lamp that has been described in claim 1, with the characteristic that the local cooling means is constituted by a liquid cooling medium and a pipe wherethrough the cooling medium flows, and a circulation pump and a liquid cooling means, that the liquid cooling means and the circulation pump are connected, and that

one end of the pipe is connected with the circulation pump, and the other end of the pipe is connected with the lamp's cooling moiety.

[Claim 6]

A metal halide lamp with the characteristic that at the time of putting out of the lamp, the lamp is switched OFF under local cooling, and that the vaporised metal halide is made to coagulate in the prescribed local cooling moiety.

[Claim 7]

A metal halide lamp with the characteristic that it is cooled so that the temperature of the upper moiety, middle moiety and lower moiety of the lamp's tube wall is lower than the temperature in the vicinity of the electrode sealing moiety.

[Detailed description of the invention]

0001

[Field of technology whereto the invention belongs]

This invention pertains to a metal halide lamp with a reflecting mirror that is arranged and lights in the front surface of the reflecting mirror, and that is used for video or general illumination.

0002

[Existing technology]

Hitherto, small metal halide lamps that had been constituted by combining a light emitting tube and a reflecting mirror, have, by characteristics such as their colour rendering being good and light emission efficiency being high, been used and been distributed as light sources of overhead projectors and projection television and projectors etc. For metal halide lamps that are used as light sources of such devices, it is required that the characteristics of the lamp do not change in the course of time, and that, in order to obtain a high luminance, the light condensation efficiency is high.

0003

[Problems that should be solved by the invention]

Hitherto, however, the actual state of affairs is that metal halide lamps have, as changes in the course of time, a change of the lamp's voltage, a decline of the colour temperature, and a decline of the intensity of illumination, and that they do not satisfy as light sources for video.

0004

With respect to the changes of metal halide lamps in the course of time, 2 changes, blackening of the tube wall by dispersion of the electrode in the initial period and devitrification of the glass tube by a reaction of the quartz glass and the sealed metal halide in the closing period were the important factors. The phenomenon of blackening in the initial period causes a change of the temperature that has a heavy influence on the decision of the vapour pressure, and it causes changes of the colour temperature that depend on changes of the temperature that have a heavy influence on the decision of the vapour pressure. The reason is that by a rise of the temperature that has a heavy influence on the decision of the vapour pressure, the vapour pressure of the metal halide in the saturated state that has been sealed inside the light emitting tube, rises.

0005

Moreover, the phenomenon of devitrification of the quartz glass that is the light emitting tube in the closing period, is a phenomenon that is generated by the fact that quartz itself evaporates, and adheres again or reacts with the metal halide that is the sealed material. The result thereof is that the light transmittance declines and that a decline of the intensity of illumination of the lamp itself is brought about. Moreover, the accumulation of metal halide that is in a state of saturation becomes a shadow at the time of light emission, and reduces the radiation efficiency of the light.

0006

This invention aims at a further rise of the efficiency of light condensation without changes of the lamp's voltage and colour temperature in the course of time. Therefore, the aim is to control the change of the temperature that greatly influences the decision of the vapour pressure, in the course of time.

0007

[Means to solve the problems]

In order to solve this problem, this invention is one that has been equipped with a local cooling means of the light emitting tube itself. Consequently, it is an invention that that controls the properties of light emission of the lamp and causes a reduction of the changes in the course of time, by the fact that it realises a site that greatly influences the compulsory decision of the vapour pressure inside the light emitting tube and controls vapour pressure characteristics of the metal halide inside the light emitting tube.

0008

[Forms of execution of the invention]

Below, forms of execution of this invention are explained, referring to figures.

0009

(Form of execution 1)

Figure 1 shows a metal halide lamp with reflecting mirror that has been equipped with a local cooling means in the first form of execution of this invention. In figure 1, 1 is the metal halide lamp, 2 is the reflecting mirror, 3 is an external lead wire, 4 is a heat insulating film, 5 is a nozzle that acts as a local cooling means, 6 is an air blowing devices with in-built air blowing fan and fan driving circuit, 7 is a lamp voltage monitoring moiety and signal calculating circuit, and 8 is a lamp driving circuit.

0010

The action of the metal halide lamp that has been constructed as mentioned above, is discussed. Figure 2 shows the structure in the case that the bottom moiety of the lamp's light emitting tube is cooled, and that the temperature of the cooling site and the voltage characteristics at this time are monitored. In the figure, 9 is a metal halide lamp wherein a well known light emitting tube with a diameter of 10 mm, a spherical form and a distance between the electrodes, 10 is an air blowing nozzle wherein the blowing opening of the nozzle has a diameter of 1 mm, 11 is an air blowing device with an in-built air blowing fan and fan driving circuit, 12 is a fan circuit controller, 13 is a lamp driving circuit, 14 is a voltage determining tool, and 15 is a radiation temperature meter. The distance of the air blowing opening of the air blowing nozzle from the lamp's tube bottom moiety is 5

mm, and the surface area of cooling of the lamp is 1.5 mm^2 . Moreover, the lamp is driven in such a way that a fixed electric power is obtained.

0011

Figure 3 is the correlation of the electric field of the lamp that has been obtained as mentioned above, and the temperature of the moiety of the bottom point of the light emitting tube. The lamp's electric field E is $E = V1a/d$. Herein, $V1a$ is the lamp's voltage, and d is the distance between the electrodes. Because distance d between the electrodes is a value that is already(?) known(?), electric field E was calculated from the the monitor value of lamp voltage $V1a$.

0012

In figure 3, a is the state without air blowing, and gradually, the degree of cooling was made stronger. With increasing strength of the degree of cooling, the temperature of the cooling site of the tube's bottom moiety declines, but the lamp's electric field does almost not change. This is domain b. When then again the degree of cooling is made stronger, the situation arrives that also the electric field changes, following the temperature of the cooling site of the tube's bottom. This is domain c. It is observed that, because in general the voltage of the lamp is established by the vapour pressure, in domain c, the cooling site is the site with a heavy influence on the decision of the vapour pressure. In other words,

in domains a to b, the site that heavily influences the decision of the vapour pressure is present in a place outside the tube's bottom moiety, but it is thought that when the temperature of the cooling site is reduced up to domain c, the site that heavily influences the decision of the vapour pressure in the tube's bottom moiety has moved.

0013

From what has been said above, it is concluded that, by local cooling of an optional site of the lamp, it is possible to move the site that heavily influences the decision of the vapour pressure to an optional site, and that the electric field of the lamp can be controlled by controlling the temperature of this site.

0014

By the fact that in a metal halide lamp that has been constructed as in figure 1, the rotation of cooling fan 6 is caused to change, corresponding with the change of electric field E, and the temperature that exerts a heavy influence on the decision of the vapour pressure, is kept constant, the lamp's electric field did not change in the course of time. Moreover, by the fact that the temperature that exerts a heavy influence on the decision of the vapour pressure, is kept constant, also the colour temperature does not change.

0015

Figure 4 shows a metal halide lamp at the time of lighting of the lamp in the case that it is not locally cooled, and 16 is the accumulation of liquid phase moiety of metal halide. In the case that no local cooling is carried out, accumulation 16 of liquid phase moiety of metal halide forms a shadow, and reduces the efficiency of radiation of light.

0016

The site that greatly influences the decision of the vapour pressure that is compulsorily realised, basically may be any moiety of the lamp's light emitting tube. In order to control the moiety of accumulation of metal halide at the time of the initial lighting, however, it is preferred that before the lighting, local cooling is carried out. When lighting is carried out in the state of local cooling, it is possible to cause the metal halide to move in the site of local cooling.

0017

Moreover, before lighting of the lamp, the temperature of the lamp may be raised by a burner or oven etc., and during the lighting local cooling may be carried out in the prescribed position. Particularly in order to obtain good vapour pressure characteristics in the metal halide lamp, heat insulating film 4 is formed in the lamp's outer moiety, and by the execution of the above mentioned local cooling process, it is possible to produce the accumulation of metal halide at the inner side where heat insulating film 4 has been

painted. Because, if the lamp is lighted in this situation, a shadow by accumulation, that is the moiety of saturation of the metal halide in the light emitting moiety, is not produced, it is possible to raise the efficiency of radiation of the light.

0018

Moreover, by the fact that in the side of the opening of the reflecting mirror, the heat insulating film moiety 4 is locally cooled also at the time of lighting, the liquid phase moiety of the metal halide is fixed in heat insulating film moiety 4. Since heat insulating film moiety 4 at the side of the opening of the reflecting mirror is a site that does not contribute to the condensation of light, the shadow of the liquid phase moiety of the metal halide is no longer present, and the efficiency of radiation of the light can be improved.

0019

(Form of execution 2)

In an actual metal halide lamp, the temperature that heavily influences the decision of the vapour pressure rises and the lamp's voltage is rises, when the time of lighting is prolonged. Consequently, it is preferred that against the rise of the lamp's voltage, the cooling capacity is changed. Figure 5 shows a metal halide lamp with reflecting mirror that has been equipped with a local cooling means in the second form of execution of this invention.

0020

In figure 5, 17 is the metal halide lamp, 18 is the reflecting mirror, 19 is an external lead wire, 20 is a heat insulating film, 21 is a pipe that acts as a cooling means, 22 is a cooling tool, 23 is a circulation pump, 24 is a lamp voltage monitor moiety and signal calculating circuit, and 25 is a lamp driving circuit.

0021

The action of the metal halide lamp that has been constructed as mentioned above, is discussed. First, the electrode sealing moiety may be the cooling moiety, because the lamp gets an extremely high temperature. By the cooling medium, the sealing moiety is cooled, and by cooling tool 22, the prescribed temperature is controlled. Moreover, because, when the time of lighting is prolonged, the lamp's electric field changes, the situation is arranged that free control of the cooling temperature is possible, corresponding with this change. The lamp voltage at this time is detected by lamp voltage monitor moiety 24, and by calculations, the cooling temperature is controlled by cooling tool 22.

0022

(Form of execution 3)

The life span of the metal halide lamp is fixed by the decrease of the light beam, but particularly cases that depend on the reaction of metal halide and quartz glass, are a main factor. The higher the temperature of the quartz tube bulb is, the earlier this reaction occurs. By the characteristics that are shown in figure 3, it was understood that the site that heavily influences the decision of the vapour pressure is not present in the bottom moiety of the tube wall, but is present in another place. Consequently, it is concluded that, even if the temperature around the tube wall is cooled as much as is possible, the characteristics of the spectrum do not change. Actually, it was observed in figure 3 that the characteristics of the spectrum do not change, even if the bottom moiety of the tube wall is cooled in domain b.

0023

The upper moiety, middle moiety and bottom moiety of the tube wall were locally cooled in such a way that the temperature of the coldest point did not change. At this time, it was actually possible to carry out lighting without changing the characteristics of the spectrum. It is thought that perhaps the site that heavily influences the decision of the vapour pressure is a site in the vicinity of the electrode sealing moiety. It is thought that in the normal lighting of the metal halide (lamp ? translator) that has been fitted in the reflecting mirror, the electrode sealing moiety in the vicinity of the reflecting mirror is the site that heavily influences the decision of the vapour pressure.

0024

[Results of the invention]

As has been discussed above, by this invention the temperature that heavily influences the decision of the vapour pressure inside the lamp is compulsorily realised locally from the outside, and the vapour pressure of the metal halide is controlled, with the result that the remarkable result that changes of lamp voltage and colour temperature in the course of time can be made small, was obtained.

0025

Moreover, also the result that it is possible to control the accumulation of the metal halide and to improve the efficiency or radiation of light, by establishing the site that heavily influences the decision of the vapour pressure in a moiety with as much as possible no influence on the light radiating moiety, was obtained.

[Brief description of the figures]

[Figure 1]

shows a metal halide lamp with reflecting plate that has been equipped with a cooling device, by the first form of execution of this invention.

[Figure 2]

shows the structure in the case that the bottom moiety of the lamp's light emitting tube is cooled, and the temperature of the cooling site and the electric characteristics at this time are monitored.

[Figure 3]

is a figure of the characteristics that shows the correlation of the electric field of the metal halide lamp and the temperature of the coldest point of the light emitting tube.

[Figure 4]

is a cross section of the metal halide lamp with reflecting plate in the existing method of lighting.

[Figure 5]

shows a metal halide lamp with reflecting mirror that has been equipped with a cooling device that depends on the second form of execution of this invention.

[Explanation of the symbols]

1, 9, 17 metal halide lamp

- 2, 18 reflecting plate
- 3, 19 external lead wire
- 4, 20 heat insulating film
- 5, 10 nozzle
- 6, 11 air blowing device
- 7, 24 lamp voltage monitoring moiety and signal calculating circuit
- 8, 25 lamp driving circuit
- 12 fan rotation controller
- 13 lamp driving circuit
- 14 tool for voltage determination
- 15 radiation temperature meter
- 21 pipe
- 22 liquid cooling tool
- 23 circulation pump

Figure 1

- 1 metal halide lamp
- 2 reflecting plate
- 3 external lead wire

- 4 heat insulating film
- 5 nozzle
- 6 air blowing device
- 7 lamp voltage monitoring moiety and signal calculating circuit
- 8 lamp driving circuit

Figure 3

tube wall
temperature
(° C)

domain b

domain c

electric field E [V/mm]